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Editorial team and responsible for the content: www.schuetziana.org/contact.php
Mario Wick, 14547 Fichtenwalde, Fichtenweg 43, Germany, mario.wick@schuetziana.org
Massimo Meregalli, 10123 Torino, V. Accademia Albertina, 17, Italia, massimo.meregalli@schuetziana.org
Wolfgang Papsch, 8401 Kalsdorf, Ziehrenweg 6, Austria, wolfgang.papsch@schuetziana.org
Tomáš Kulhánek, 67201 Moravský Krumlov, Tylova 673, Czech Republic, tomas.kulhanek@schuetziana.org.
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Cover picture: *Gymnocalycium alenae,* Tom 09-502/1, San Francisco de Chañar, province Córdoba, Argentina (photo: T. Kulhánek).

Editorial

Dear Gymnocalycium enthusiasts

Wolfgang Papsch

There is still a lot to discover within the *Gymnocalyciums*, northern Córdoba especially has some more surprises in store. This seems to be a hotspot of development and differentiation of *Gymnocalycium* species. In this issue Tomáš Kulhánek describes *Gymnocalycium alenae* as a new species from that area. With the utmost probability it is a population of hybridogenous origin with *G. taningaense* and *G. affine* as its "parents". The amazing fact is the long distance of about 200 km from the nearest population of *G. taningaense*, which occurs south of Guasapampa in the same province. This paper thus presents the first proof of *G. taningaense's* genetic influence in northern Córdoba.

In 1941 Cornelius Osten PhD described *Gymnocalycium schroederianum* from the Uruguayan banks of Río Uruguay in honour of his friend J. Schröder PhD. At that time it could not be foreseen what a large distribution area this species populates. Roberto Kiesling was the person to enlarge the area by 300 km to the north and 500 km to the south – still assuming that it was one single species, namely *G. schroederianum*. Later intensive study of Spegazzini's publications brought us to the conclusion that *Echinocactus platensis* from Olavarria described by him is the oldest name of this plant group.

Roberto Kiesling divides the species into three subspecies, while David Hunt and Graham Charles regard the subspecies merely as synonyms. The morphologic differences between the subspecies are indeed, with few exceptions, only slight and indistinct between the individual populations. More importance must be attached to the geographical distance between the subspecies. Apart from this the varying conditions of the habitats are also considerable. Both facts show that one species can adapt to diverse ecological situations, but the resulting appearances of the plants have never created any doubt that it is just one single species.

We would like to express our warmest thanks to Mrs Iris Blanz (Fernitz, Austria), to Mr Brian Bates (Bolivia) and to Dr. Graham Charles (United Kingdom), who support us with the translation into English, to Mrs Larisa Zaitseva for the translation into Russian (Tscheljabinsk, Russia), to Mr Takashi Shimada (Japan) for the translation into Japanese, to Mr Mohamad Hajizade for the translation into Persian (Teheran, Iran) and to Mr Daniel Schweich (France), who has mirrored our publications under http://www.cactuspro.com/biblio/.

Franz Strigl – 80 years and still young at heart

Ulf Marx

Bachweg 25, 5412 Puch bei Hallein, Austria
E-Mail: ulf.marx@gmx.at

Tomáš Kulhánek

Tylova 673, CZ-67201 Moravský Krumlov, Czech Republic
E-Mail: tomas.kulhanek@schuetziana.org

Fig 1: Franz Strigl in his greenhouse in 2016 (picture: U. Marx).

It is hard to believe that our still very active Gymno-friend Franz Strigl celebrated his 80th birthday on July 16th, 2017. He is in perfect health and many of us do not only know him as a lover of Gymnocalyciums, but also as a field researcher, author, chairman of his GÖK Tyrol Lowlands local group and particularly as a friendly host to all visitors of his considerable collection in Kufstein.

Franz is, in fact, not really a Tyrolean, but was born on July 16th, 1937, in Kleinarl in the province Salzburg. He lost his father in the war as early as in 1944. His mother had to bring up three children on her own in those hard times. After completing secondary school in St Johann im Pongau, Franz trained as a tinsmith and plumber, but he already changed to the post office in Kufstein in 1958. There he took several exams up to A-level standard and beginning in 1971 he was in charge of the profitable postal delivery department for as many as 25 years until he retired.

At the end of the 1950s his then-girl friend and later wife Hanneliese brought the first cacti to their common flat and in 1960 the couple celebrated their wedding. As with most cacti lovers, the plants were cultivated first on a window sill, which changed quickly when the engraver Günther Moser relocated from Vienna to Kufstein in 1966. He had designed the GÖK emblem and was already in touch with Adolfo Maria Friedrich in Paraguay, although he himself had never been to Latin America. For the time being the plants were cultivated by Franz in a hotbed in the general garden shared by the residents of his block of flats.

In the early 1960s Franz regularly visited his probably most important Gymno-friend Hans Till, who was in charge of a garden centre near lake Attersee.

From 1963 onwards Franz was regularly in touch with the Innsbruck cacti friends, but was particularly interested in a co-operation with Günther Moser, who was in contact with Adolfo Friedrich in Paraguay. Friedrich had been a war correspondent in the Chaco war (1933-1935) and collected cacti there on behalf of PhD Hassler (Swiss botanist at the Botanical Institute in Asuncion). During his curatorship 42 new varieties were found in the 1930s and also sold to merchants, such as the Italian Oreste Marsoner and the German Harry Blossfeld. Friedrich stopped collecting and exporting cacti for economic reasons. Starting in 1963 Moser was in contact with him and got 6,000 plants along with hundreds of pictures, letters, maps and books from Friedrich in the course of a 16 years' co-operation, as Moser reports in his book on Adolfo Maria Friedrich.

Together with Günther Moser, Franz, who is at least more than one and a half decades younger, finally established a shared collection in the abandoned garden centre Wessely in Kufstein in 1976. However, they had soon to leave and they built a 3 x 12 m greenhouse on a leased communal plot of land under their own steam. This was not difficult for Franz as he is a skilled tinsmith. Between 1967 and 1975 the two cacti friends were invited to Czechoslovakia for lectures several times. Due to the Iron Curtain, border formalities were not easy and took a long time, but the Czechs had suffered hardly any losses of plants during the war. They were not field researchers, but possessed seedlings from Alberto Vojtěch Frič's plants and so it was especially interesting for the two Austrians to visit cacti lovers like František Pažout, Miroslav Voldán, Jan Valníček, Zdeněk Fleischer, Stanislav Stuchlík, Jan Pechánek or Bohumil Schütz. Schütz, Pechánek und Stuchlík also visited Franz repeatedly in Kufstein. Up to date Franz has stayed in touch with his cacti friends in the present-day Czech Republic.

Fig. 2: Franz Strigl, Klaus Billet and Günther Moser, Kufstein 1989 (picture: J. Procházka).

Fig. 3: Jaroslav Procházka, Klaus Billet, Franz Strigl, Vít Kopecký, Günther Moser, Kufstein 1989 (picture: J. Procházka).

In 1975 Franz acquired the rest of a plot of land after the construction of the motorway section at Kufstein. Nowadays this is the place where his greenhouse with its attached study is located. During that time Franz got interesting plant material from Hans Till, who, together with Stefan Schatzl, PhD Simon and a Mr Peham from Salzburg, had the purchase option for the imported deliveries from Mrs Muhr and Helmut Fechser to the German garden centre Uhlig. The cacti importer Helmut Fechser visited our birthday gentleman in person in Kufstein. In the 1970s the plants were being shipped over many weeks and so it happened that Franz got two *G. tillianum* from Mr Fechser, sr. before the first description of this plant was published by Walter Rausch, who, as is generally known, found *G. tillianum* together with Mr Fechser, jr. These original plants are now in Massimo Meregalli's collection.

In 1975 Franz travelled to Mexico for the first time, together with a group of twelve travellers (among others Ernst Zecher, Ernst Markus, Stefan Schatzl). As there were not merely cacti lovers in this group, Franz organised another trip to Mexico together with Erich Haug in 1976. Five more expeditions to Mexico were to follow up to 1983. At that time travelling to Mexico was very fashionable and it was still allowed to take plant material to Europe. Beginning in 1971 and for 40 years, Franz was the chairman of the Tyrolian Lowlands local group, which in their heyday at the beginning of the 1990s had as many as over 50 members.

Fig. 4: Franz Strigl in his greenhouse, Kufstein 1989 (picture: J. Procházka).

In May 1987 the lead author, still a young grammar school student, travelled together with Franz, Hans Till and Fred Steiner to the 2nd European Gymnocalycium Symposium in Darmstadt. While on the road, the high production costs of a book on the genus *Gymnocalycium* were discussed and soon the idea was brought up to publish periodically in form of a loose leaf edition. Franz agreed to designing the general part of the publication. Hans was responsible for

the scientific part and Fred dealt with layout and printing. Until 1992 Franz was in charge of the editorial department of “Gymnocalycium”. Still in Darmstadt, Hans and Franz decided to go on their first common journey to Argentina, because they were so enthusiastic about the idea of being able to publish the latest state of Gymnocalycium research. At the same time Franz remembered his connection with the emigrated Tyrolean Friedrich Gut, who had lived in Aqua de Oro / Córdoba with his family since 1945. This relationship originated from an article in the Tyrolean daily newspaper on how Tyrolean people live abroad. These articles were published in the newspaper during the Christmas season. Because of the cordial reception and the Gut family’s support, Aqua de Oro became a sort of home base for all STO journeys. After Friedrich Gut’s death in 1989 the opportunity to buy a house in Aqua de Oro came up, and finally Franz did so, together with Helmut Amerhauser. In 1988, during their second journey, Franz Strigl, Hans Till, Fred Steiner and Helmut Amerhauser planted more than 200 Gymnocalycium specimens in a garden in Aqua del Oro. However, only few plants survived the first year from lack of care and fostering. In retrospect they also realised that it did not make sense to let original plants from various localities flower and produce seeds in an unregulated manner.

Between 1987 and 1999 Franz took part in a total of eleven expeditions to Argentina with varying participants in the team.

A particularly pleasant fellow traveller for Franz was his Tyrolean friend Helmut Rupprechter. Our birthday gentleman was also often accompanied by his wife Hanneliese, who always supported him actively in his research. During those twelve years he travelled especially the provinces Córdoba, Catamarca, Tucumán, Salta, Mendoza, Jujuy und La Rioja. During these trips it could be noticed repeatedly that plants with a brown epidermis were mostly hidden under bushes. This fact should be taken as a hint for plant care, as Franz realised.

In 2012 his wife died after a long time of medical care. During this difficult time the cacti had, of course, to do without his otherwise dedicated tending to them. Despite his severe loss, Franz started again to concern himself more intensively with his collection at the age of 75. He opened his two greenhouses once more to all interested cacti lovers and visitors.

Franz also resumed his international contacts then, for example with the botanical garden in Singapur, which houses the world-wide largest orchid exhibition on an estate of 74 hectares and has 4.2 million visitors every year. With the help of his cousin, who lives there, Franz donated some plants to Asia. To his surprise he was invited to a journey to Singapur by the garden management in 2015. Our birthday gentleman is still not sure whether or not to set out on this journey.

Fig. 5: *Deuterochonias* and *Parodia* at the roadside, 1993 (picture: F. Strigl).

Franz has always been an enthusiastic field researcher who has tried to transfer his experiences and observations at the habitat with the correct tending to the plants in greenhouses. In his opinion it is a mistake to believe that *Gymnocalyciums* with a brown epidermis need a lot of sun, on the contrary, plants from the Chaco in Paraguay need less sun, slightly warmer winters and not too dry summers. They have fibered roots and need a humic soil substratum.

Franz has always regarded it as a mistake not to take an average plant from a locality for the first description of a taxon in specialist literature. Mostly an extreme form of the plant has been used and deposited as holotype.

Over many years he has occupied himself with sowing and nurturing cacti. Above that he has published some seed lists in order to make it possible for other cacti lovers to obtain seeds.

Since the 1960s Franz has published numerous articles, in the beginning in the “Stachelpost” (“Spine Mail”), after 1972 in “Kakteen und andere Sukkulenten” (“Cacti and other Succulents” (47 articles). Since 1988 he has been the author of 26 articles in “Gymnocalycium”. In his contributions to the individual specialist magazines he has dealt with tending to and propagating cacti from various genera and *Gymnocalycium* in particular, of course. At this point two of his first descriptions shall be mentioned: *G. riojense* subsp. *paucispinum* var. *guasayanense* (Gymnocalycium 4 (4):57 (1991) and together with Walter Till *Gymnocalycium schatzlianum* (KuaS 36 (12): 250-253 (1985)). In his honour the Austrian Walter Jeggle described *Gymnocalycium striglianum*, which Walter Rausch had found in Mendoza during his fifth Latin America expedition in1973.

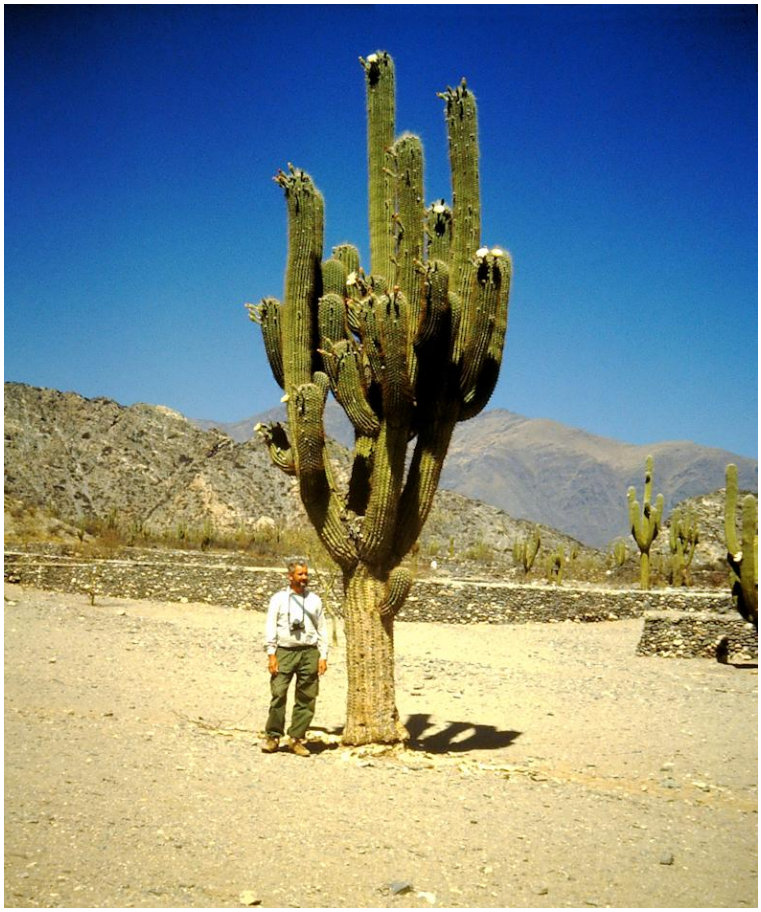


Fig. 6: Franz together with *Trichocereus pasacana* in Quilmes, Tucumán (picture: F. Strigl).

Fig. 7: The authors together with Franz, 2013 in Kufstein (picture: U. Marx)

Today Franz still regrets not only that the authors of the individual specialist magazines put too little emphasis on cultivating, tending to and propagating the plants, but also that in scientific research the historical background is neglected, because "…the Gymnos do not fly in through the door…" as he was joking in an elaborate interview in summer 2016.

We are grateful to Franz Strigl and Jaroslav Procházka for providing the slides published here.

Our special thanks go to the birthday gentleman himself for the multitude of hours and days during the recent years of telling us about his interesting life. We wish him all the best on the occasion of his 80th birthday, the best of health and many happy hours with his new companion Erika and, not to forget, his cacti.

Fig. 8: Franz and his beloved Gymnos, 2016 (picture: U. Marx).

On the Distribution of *Gymnocalycium platense* (Spegazzini) Britton & Rose (*Cactaceae*)

Wolfgang Papsch

Ziehrerweg 5, A-8401 Kalsdorf, Austria
E-mail: wolfgang.papsch@schuetziana.org

ABSTRACT

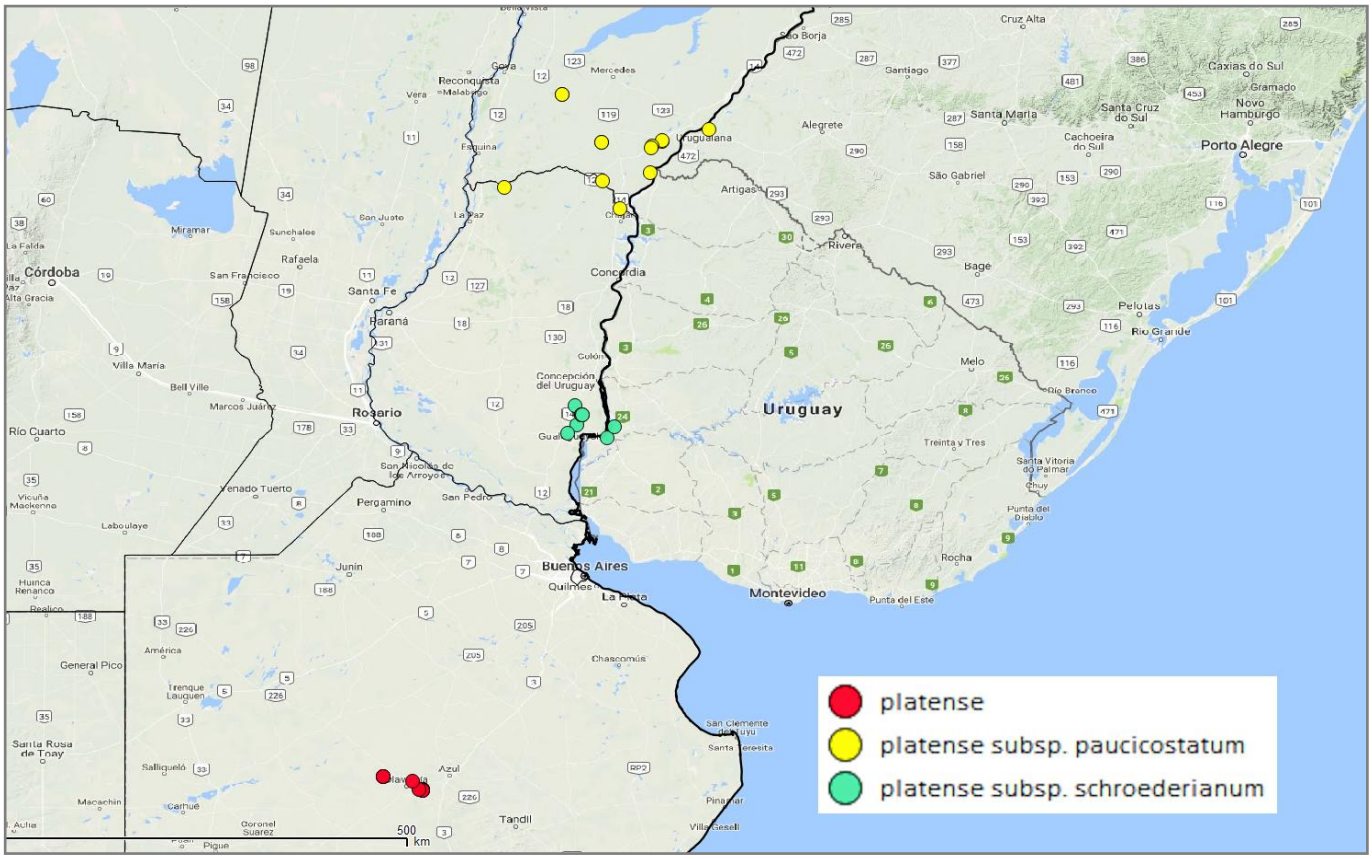
The distribution area of *Gymnocalycium platense* and its subspecies is outlined. In doing so, well-defined subareas can be assigned to the subspecies described. The different ecological conditions of these localities are discussed and compared.

KEYWORDS: *Gymnocalycium platense*, *Gymnocalycium platense* subsp. *schroederianum*, *Gymnocalycium platense* subsp. *paucicostatum*

INTRODUCTION

In 2015 the situation of systematics and nomenclature of *Gymnocalycium platense* (Spegazzini) Britton & Rose and its subspecies was discussed in the magazine Schütziana. After clarification of these issues the necessary changes in nomenclature were formally implemented in order to take into account the results of the study (Papsch 2015a, 2015b). However, ecological as well as geographical aspects of the area were largely not considered, as Roberto Kiesling had already had a short look at this matter in his study of these plants (Kiesling 1987).

The entire area of the species extends over a huge region in north eastern Argentina, its north-south expansion covering more than 800 km, in shape similar to a triangle standing on one vertex. The individual subspecies populate well-defined parts of the area, with two subspecies (subsp. *schroederianum* and subsp. *paucicostatum*) extending into Uruguay and Brazil at the eastern side of the distribution area. As far as ecology is concerned, there are vast differences between the habitats of the typical subspecies and those of the two other subspecies. In geographic respect, the disjunctive separation of the subspecies is remarkable, this finding is based on analysis of locality data from numerous collections (AP, GC, GN, Herm, HU, JPR, KH, LB, P, Tom, VoS, WG, WP and WR).

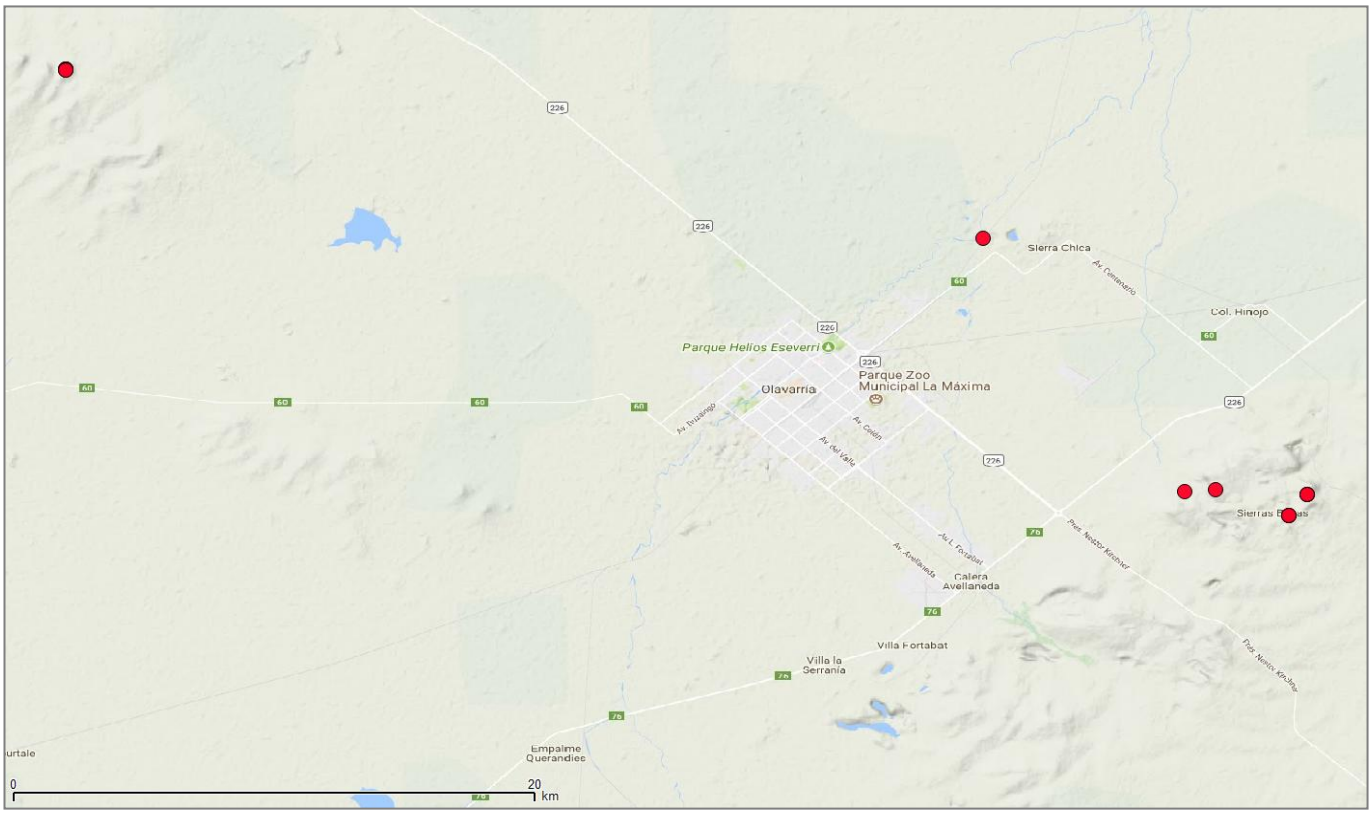


Map 1: Geographic position of the localities of *G. platense* sensu lato.

THE DISTRIBUTION AREAS OF THE SUBSPECIES

1. Gymnocalycium platense (Spegazzini) Britton & Rose subsp. *platense*

As already stated by Kiesling, the small habitats of *G. platense* subsp. *platense* are situated on only a few low hills around Olavarria in the province Buenos Aires. This can be found in the above quoted papers of the author, yet under the name *G. schroederianum* subsp. *bayense*. In geological respect these hills are part of the Tantilla mountain system, forming the north-western foothills. The Sierras Bayas group of the late Precambrian is formed by sedimentary Villa Mónica-, Cerro Largo- and Loma Negra-formations, which are mainly formed by quartzite and dolomite and which are sometimes covered by slate (Massabie & Nestiero 2005). Extensive quarrying mainly for the production of cement and for the ceramic industry has destroyed many of the hills with their old caves and grottos. That is why *G. platense* can only be found in a few places in the central area of the Sierra Bayas, such as on Cerro Matilde. In the farming area following to the north with its separate, isolated hills the situation is slightly better, for instance on Cerro la China.



Map 2: Geographic position of the localities of *G. platense* subsp. *platense.*

Typical of this subspecies's localities are slightly inclined grasslands interspersed with rocks and with few or no bushes at an altitude of 240 to 270 m a.s.l. The plants grow in black soil (accumulated humic soil) between rocks which are cleaved in a blocky fashion. Analyses of soil samples from the localities Sierras Bayas and Cerro la China yielded results which were to be expected of eutrophic pampa soil, although they differ significantly with respect to their nitrogen (N), phosphorus (P), potassium (K), manganese (Mn) and especially calcium (Ca) contents (Huber & Papsch 1995).

Fig. 1-2: Typical sites of *G. platense*: Sierras Bayas (1), Cerro la China (2).

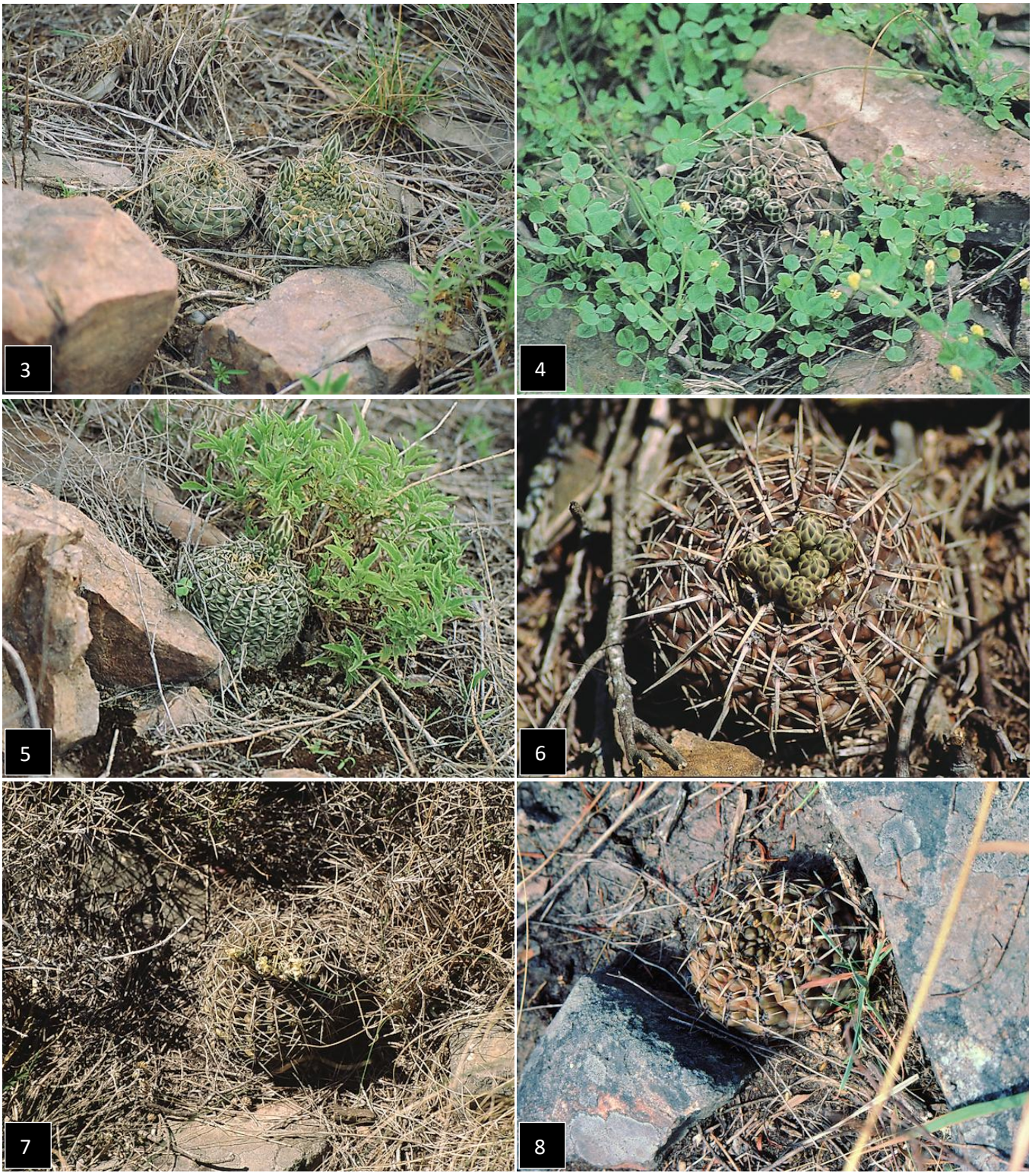


Fig. 3-8: *G. platense* subsp. *platense* in the rocky habitat of Sierras Bayas: Cerro Matilde, Abra de Manrique (3). Cerro Aguirre, Boca de Diabolo (4), Cerro Largo (5); Cerro la China (6-8).

Fig. 9: *G. platense* subsp. *platense* WP 112-149 Sierras Bayas, flowering in cultivation.

2. *Gymnocalycium platense* subsp. *schroederianum* (Osten) Papsch

The localities of *Gymnocalycium platense* subsp. *schroederianum* are geographically concentrated in the south-east of the province Entre Rios, to the left and right of Río Uruguay near the city Gualegaychu and thus about 500 km north of Olavarria.

Many rivers border and flow through the province Entre Rios. To the west and south it is bordered by Río Paraná, to the east by Río Uruguay and Río Mocoretá and to the north by Río Guayquiraró. As part of the Argentinean Mesopotamia, the province Entre Rios is almost completely flat. The highest elevation has a maximum altitude of just 100 m. Large areas are flooded again and again in heavy rain.

In the north-east of Argentina, the humic soil of the pampa (phaeocemes) merge into vertisoles due to moist climatic conditions and fine clay-containing substratum. The vertisoles are brought about by hydroturbation. The extremely dense loam there tends to crack in dry periods; still it offers sufficient fertility for pastures. The silty clay-containing sediments with their high proportion of montmorillo clay form the Pampa loessica of Entre Rios, which merges into the Uruguayan pampa to the east. Those are the characteristic soils of Entre Rios and western Corrientes. The natural flora of vertisoles consists of grasses, bushes and scattered trees, such as the Quebracho (*Apisdosperma quebrachoblanco*, *Apocynaceae*), the Chañar (*Geofroea decorticans*, *Fabaceae*) or the Algarroba (*Prosopis spec.*, *Fabaceae*).

Map 3: Geographic position of the localities of *G. platense* subsp. *schroederianum.*

G. platense subsp. *schroederianum* was described for the first time as an individual plant by Cornelius Osten 70 years ago as *G. schroederianum* Osten from Nueva Mehlem near Berlin on the Uruguayan side of Río Uruguay (Osten 1941). All localities of *G. platense* subsp. *schroederianum* known so far are situated within a circle of 50 km in diameter and at an altitude of 10-30 m on both sides of the Río Uruguay. Potential localities are areas of fine sand along streams, such as the lower Río Gualeguay and its tributaries, which are flooded at regular intervals. While the streams are mostly lined with dense bush and tree vegetation, fine sediments are deposited behind them in times of flooding, forming characteristic lighter zones with little bush vegetation. All the known localities of the subspecies *schroederianum* have been found in such sediment zones. The localities on the eastern side of Río Uruguay are of the same characteristics, too. In his first description Osten says that the plants grow in boggy areas (“in limo pampeano”, Osten 1941). Within the otherwise intensely used agricultural terrain these areas form small refuge areas for the plants. *Harrisia spec.*, *Opuntia paraguayense*, and sometimes also *Frailea pumila, Parodia turecekiana* and *Echinopsis eyriesii* also grow at the localities *of G. platense* subsp. *schroederianum.*

Fig. 10: Typical sites of *G. platense* subsp. *schroederianum* nearby Gualeguaychú.

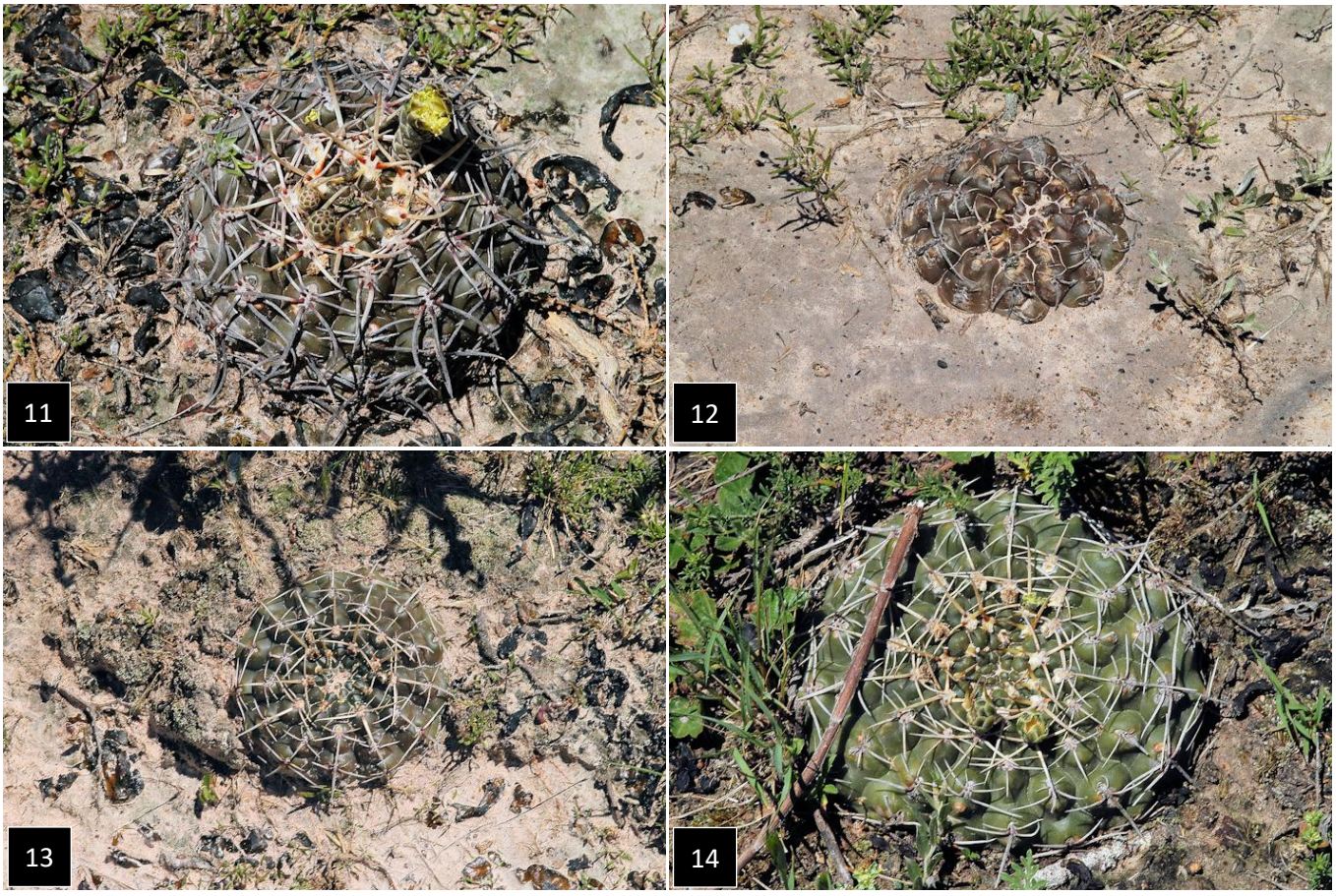


Fig. 11-14: *G. platense* subsp. *schroederianum* at localities around Gualeguaychú.

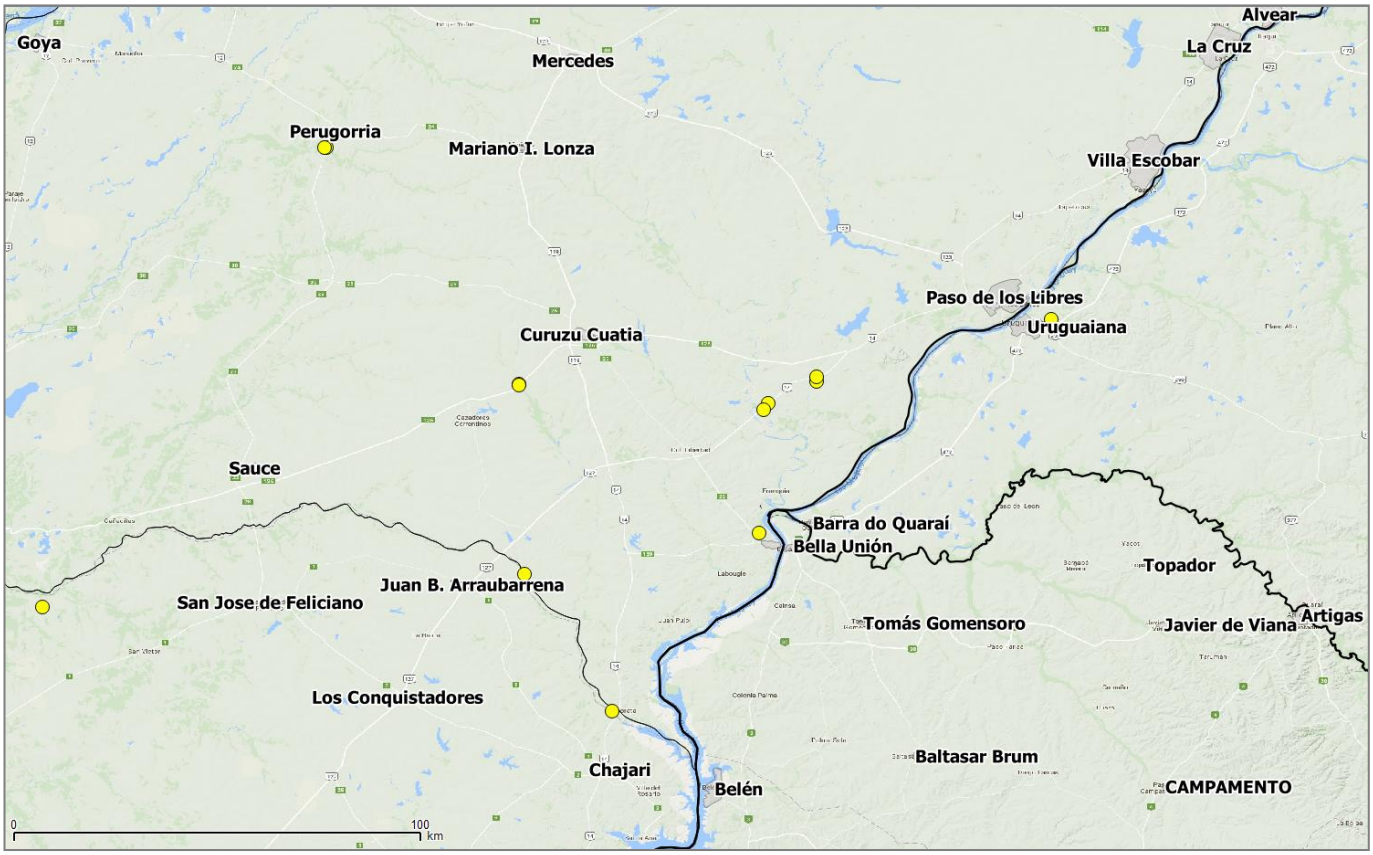
Fig. 15: *G. platense* subsp. *schroederianum,* SNE 04-2 Gualeguaychú, flowering in cultivation.

3. *Gymnocalycium platense* subsp. *paucicostatum* (Kiesling) Papsch

The localities of *G. platense* subsp. *paucicostat*um stretch in form of a 100 km wide strip from south of the province border of Entre Rios into the southern part of the province Corrientes. Thus they are situated about 300 km north of the localities of the subspecies *schroederianum*.

The province Corrientes is also situated between Río Paraná and Río Uruguay and is therefore part of the Mesopotamia as well. The area is almost completely flat, with the exception of the slightly hilly north-east, which already merges into the mountainous country of Misiones. The characteristic savannah vegetation with small forests prevails. With respect to geology and vegetation, the southern part of the province, where most of the habitats of the subspecies *paucicostatum* are situated, follows seamlessly on the habitats of the province Entre Rios. Even the characteristics of the localities of this subspecies are similar to those from around Gualeguaychú.

In the flood zones along the rivers, as for instance Río Gualeguay, Río Guayquiraró or Río Mocoretá and their tributaries, numerous localities have been found at altitudes between 35 m (Paso Yunque) and 75 m (Perugorria).



Map 4: Geographic position of the localities of *G. platense* subsp. *paucicostatum.*

The westernmost populations were found at Paso Yunque on Río Guayquiraró, where the plants grow in a level flood zone on somewhat elevated sods. Perugorria is the northernmost known locality. The most eastern locality is located near Monte Caseros and along Río Miranay, the Río Mocoretá marks the southernmost known locality. With the collection WG 152 near Uruguaiana in Brazil by Wolfgang Gemmrich, also called *G. schroederianum*, the distribution area is enlarged once again by 50 km across the national border to the east.

Fig. 16-17: Locality of *G. platense* subsp. *paucicostatum* at Paso Yunque.

Fig. 18-19: *G. platense* subsp. *paucicostatum* at Paso Yunque.

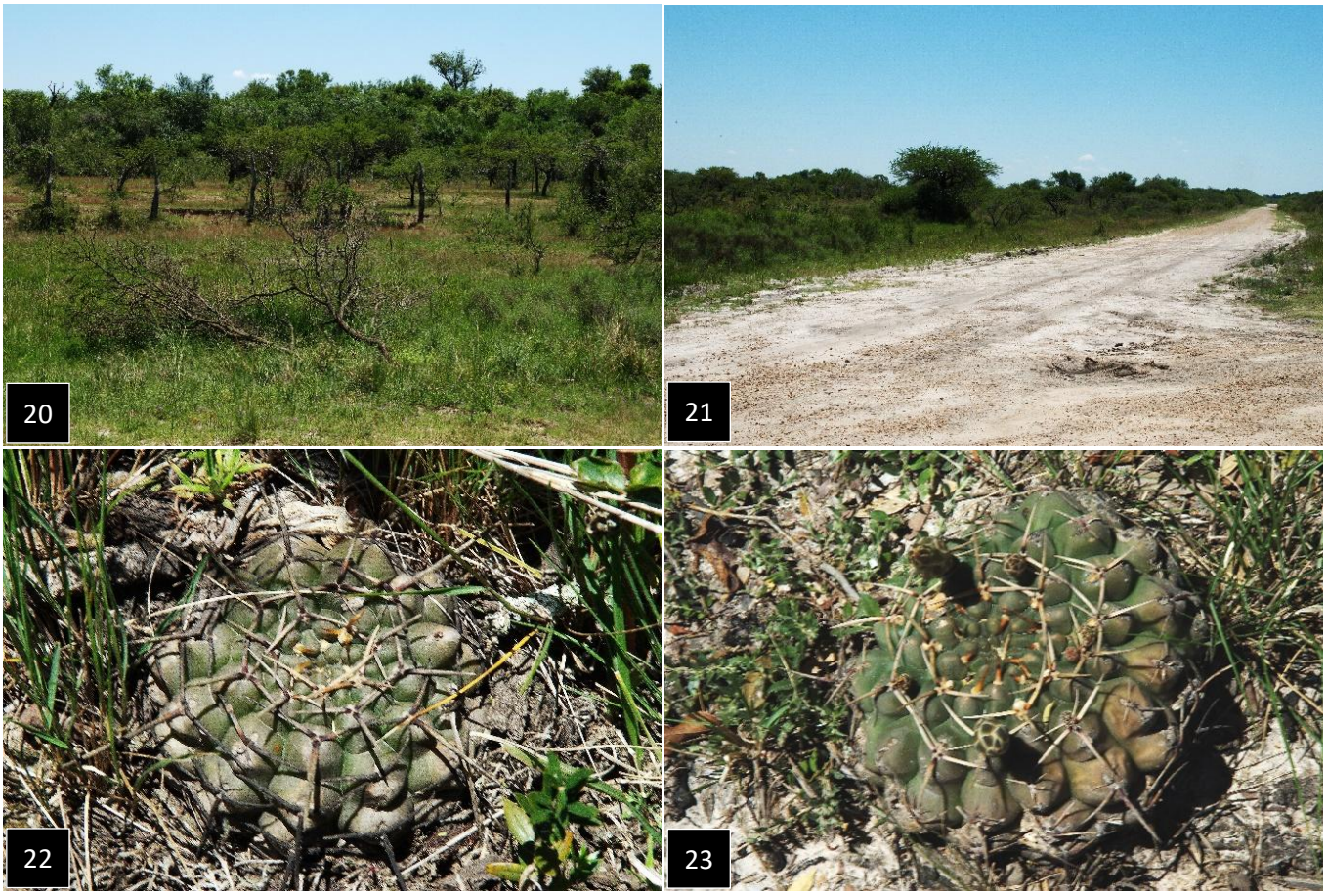


Fig. 20-23: *G. platense* subsp. *paucicostatum* at Arroyo Tuna.

In his paper Kiesling quotes further localities which might be linking populations between the subspecies *schroederianum* and the subspecies *paucicostatum.* Unfortunately, detailed locality data are not mentioned. During the study trip at the end of 2016 the focus was put on potential localities in the west of the province Entre Rios. *G. platense* could not be found along the line Ubajay-Chuchilla Grande-Villagay and along Río Gualeguay and neither between Villagay and La Paz across Chuchilla de Montiel. However, it must be added that visiting possible localities is often simply impossible after rain showers. Therefore, it cannot be excluded that possible localities exist within the area outlined.

Fig. 24: Typical site of *G. platense* subsp. *paucicostatum* at Río Miranay.

Fig. 25-26: *G. platense* subsp. *paucicostatum* at Río Miranay.

Fig. 27-28: *G. platense* subsp. *paucicostatum VoS 1535, Perugorria (photo: V. Schädlich).*

CONCLUSION

G. platense grows in three geographically distinctly separated areas in the provinces Buenos Aires, Entre Rios and Corrientes. The two subspecies *schroederianum* and *paucicostatum* share the lowlands of the northern provinces, which have abundant water, thus both preferring the same habitat criteria: Alluvial regions with a high proportion of loam along streams and rivers at a low altitude of between 10 and 75 m. They can also be submerged for lengthy periods in times of flooding. As opposed to other opinions (e.g. Hunt 2006, Charles 2009) the distinctly separated areas support the continuance of the two subspecies.

The area where *G. platense* sensu stricto grows is not only geographically extremely separated from the other subspecies, but also differs greatly in geological and ecological respect. In these localities humic soil with partly large outcrops of rocks prevails. The distinct separation between the southern habitat and the individual parts of the northern area is hard to explain now. Maybe there used to be a distribution bridge from the Sierras Bayas across the chain of lagunas, as e.g. the Laguna Pluma, in the direction of Buenos Aires and beyond.

Fig. 29: *G. platense* subsp. *paucicostatum* LB 960 Curuzú Cuatiá, flowering in cultivation.

ACKNOWLEDGEMENT

We are grateful to Volker Schädlich for providing pictures of the locality Perugorria and to Mario Wick for the design of the maps (source of the map backgrounds: Google Earth).

GLOSSARY

Hydroturbation, also called peloturbation, is biological rearrangement of soil due to repeated moisture expansion and shrinking. This occurs mainly in changing moisture and with substrata capable of swelling, for example three-layer clay minerals such as montmorillonite.

Mesopotamia (Argentina) is situated between the two rivers Río Paraná and Río Uruguay and spans the three provinces Entre Rios, Corrientes and Misiones.

Montmorillonite is a frequently occurring mineral from the silicate and germanate mineral group and thus chemically a sodium-aluminium-silicate. Monrmorillonite is structurally a silica sheet.

Phaeozem (from Greek: phaios = dark, and Russian: semlja = soil): A type of soil of the international soil classification WRB which is classified as humic accumulation soil. It is the zonal soil of the semi-humid transition region between steppe and forest.

Vertisoles: According to WBR soil classification soils of the semi-humid tropics and semi-tropics. They are characterized by a high proportion of loam. They can be found world-wide in regions with heavy seasonal fluctuation in rainfalls.

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Gymnocalycium alenae Kulhánek, a new species from the northern part of province Córdoba

Tomáš Kulhánek

Tylova 673, CZ-67201 Moravský Krumlov, Czech Republic
E-mail: tomas.kulhanek@schuetziana.org

ABSTRACT

A new taxon of the genus *Gymnocalycium*, subgenus *Gymnocalycium* (*Cactaceae*) was investigated in the northern part of the province Córdoba, Argentina and evaluated as a new species of possibly hybridogenous origin, partly related to the *G. taningaense* Piltz species group. A detailed plant description with differential diagnosis is provided. Information about ecology and possible relationships with other related taxa are given.

KEYWORDS: *Gymnocalycium*, *Gymnocalycium alenae*, North Córdoba

INTRODUCTION

The northern part of the Córdoba province has been intensively studied in recent years with regard to the occurrence of various *Gymnocalycium* populations. Some of them were already described a long time ago (*G. erinaceum* J. G. Lamb., *G. robustum* Kiesling, O. Ferrari et Metzing, *G. parvulum* Speg. (Speg.) subsp. *huettneri* F. Berger, *G. parvulum* Speg. (Speg.) subsp. *agnesiae* F. Berger), several other populations have been investigated and found to be new species in recent times (*G. kuehhasii* Neuhuber et Sperling, *G. affine* Řepka, *G. campestre* Řepka). The two latter species strongly reflected hybridogenous origin; this was finally confirmed in *G. campestre* by the study of Řepka et al. (2015). *G. affine* can be partly affiliated to the *G. robustum* species group and, especially in its southern area of distribution, to the *G. leptanthum* Speg. species group*.

During field research in the area of Sierras Ambargasta and Sumampa in 2009 and 2012, I wanted to explore different kinds of habitats where various *Gymnocalycium* may occur. A few kilometres south of San Francisco de Chañar in the vicinity of Estancia La Quinta, a population occurs representing small solitary plants, which at first glance could be mistaken for small plants of *G. affine* Řepka. The remains of small empty fruits had already been seen in habitat, indicating earlier flowering plants in contrast to other taxa present in this region. Here the idea was born of a possible relationship with another earlier flowering species group – *G. taningaense* Piltz. Since that time plants have been studied more in culture, moreover, seedlings raised from habitat seeds collected in 2009 and 2012 have provided flowers, fruits and seeds. According to these characteristics observed later in culture and stated here, I have decided to describe this plant at species level with evidence of possible hybridogenous origin.

(**G. leptanthum* Speg. is the valid name and used for the indication of the species group with the priority over *G. parvulum* Speg. (Speg.), see also Papsch, 2015 and Meregalli, 2016.)

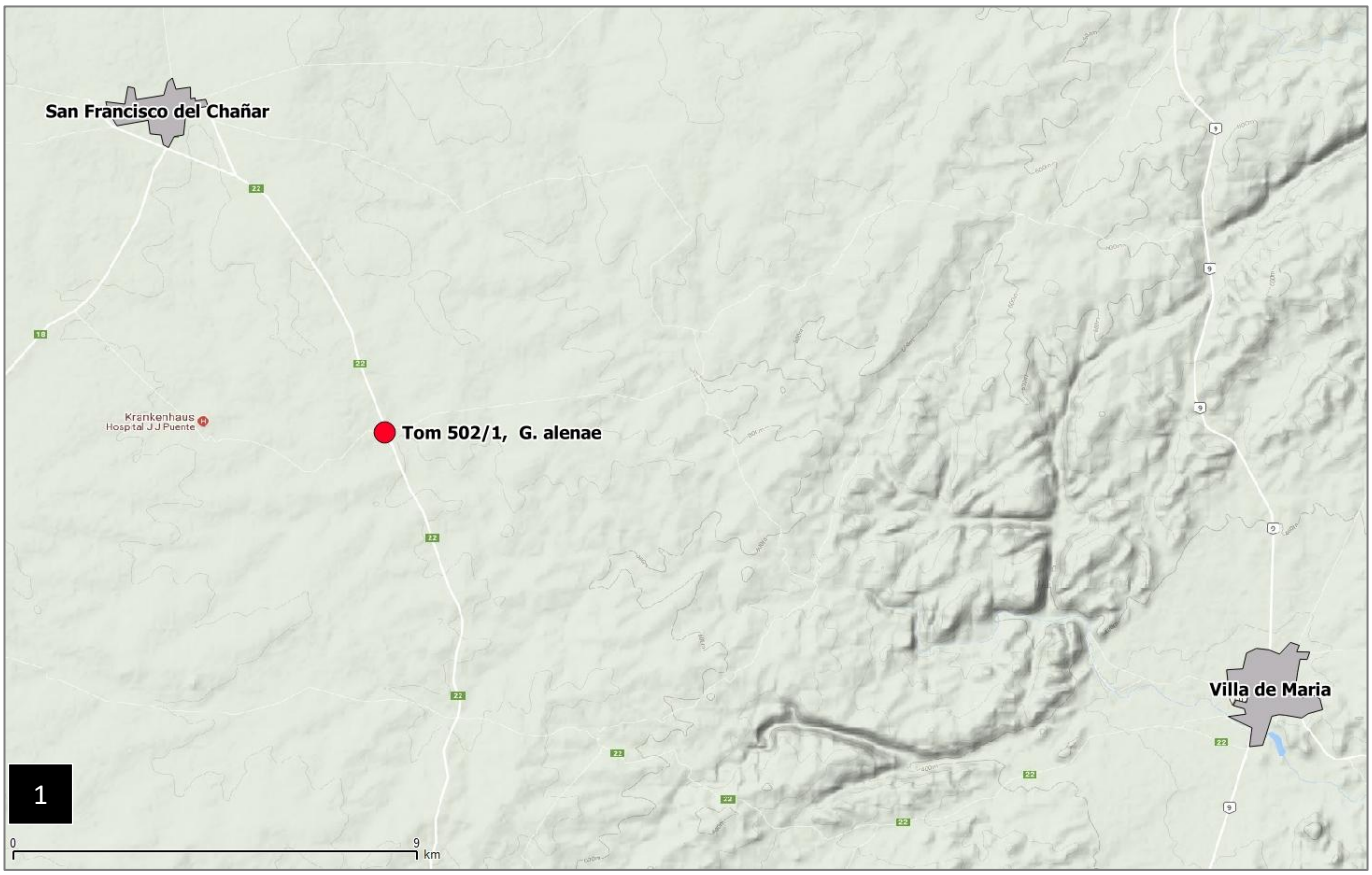

Fig.1: Type place of *G. alenae*, near Estancia La Quinta (map: Google Maps, by Mario Wick).

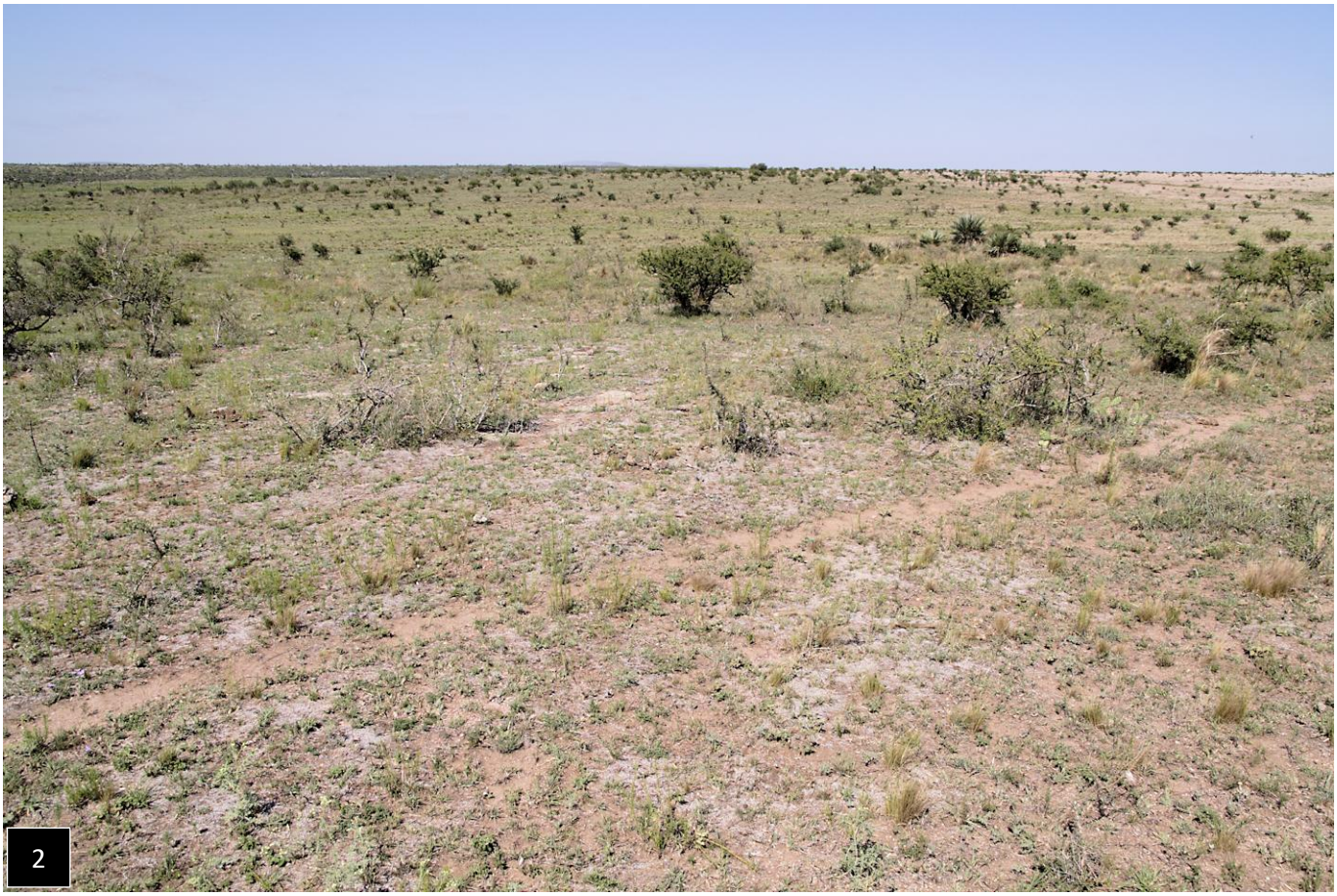

Fig. 2: Habitat of *G. alenae* Tom 502/1.

Fig. 3-7: *G. alenae* Tom 502/1, variability in habitat.

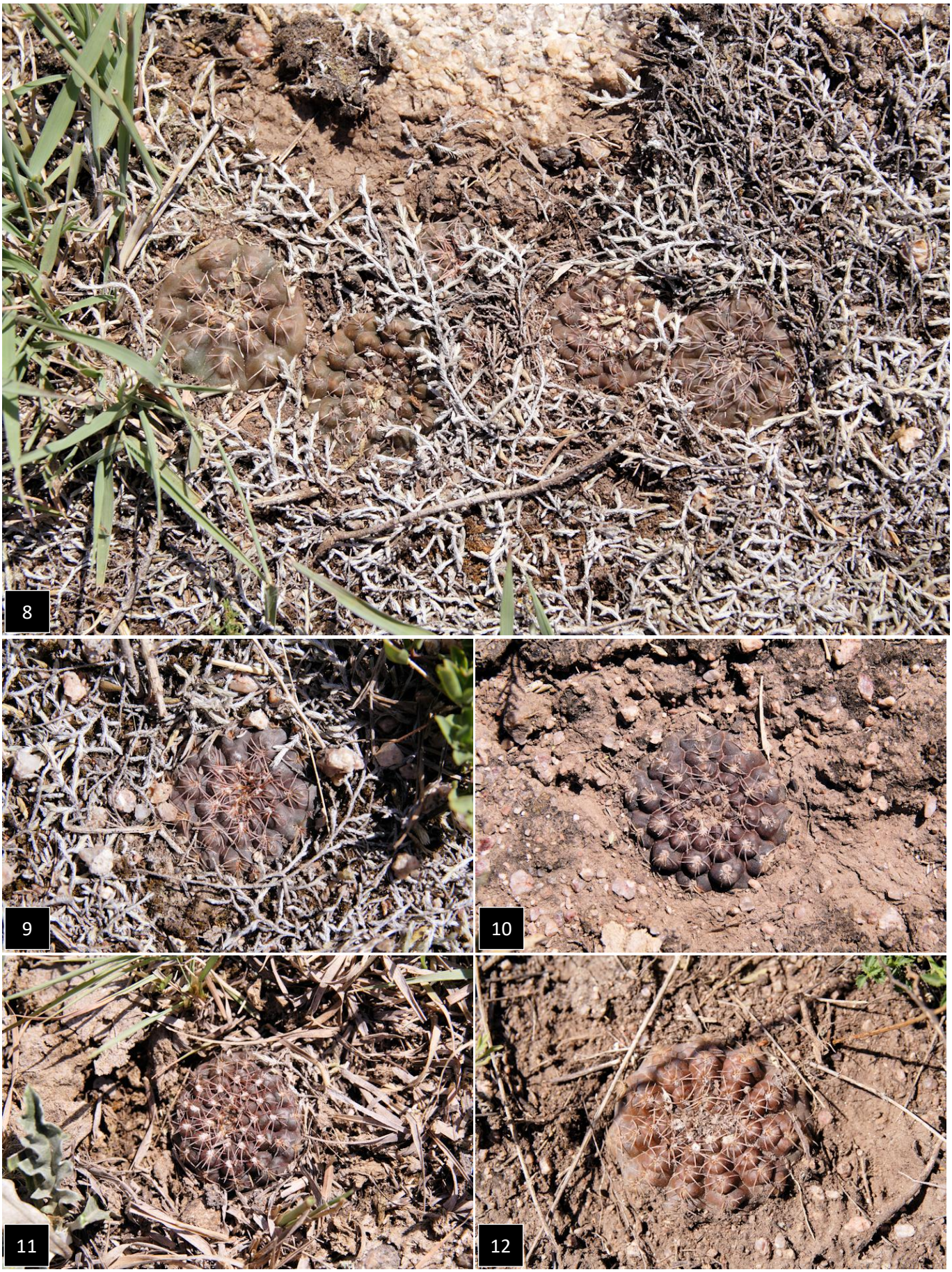

Fig. 8-12: *G. alenae* Tom 502/1, variability in habitat.

Gymnocalycium alenae Kulhánek species nova

Type: Argentina, prov. Córdoba: Sobremonte, Estancia La Quinta, in pure pasture with *Acacia caven* Molina in sandy soil, NW of crossroads connecting RP 22 and its side road RP 18, 648 m above s.l., leg. *T. Kulhánek* Tom 09-502/1, January 2009, (Holotype: CORD; Isotype: WU-0093296).

DIAGNOSIS

Affiliated to the *Gymnocalycium taningaense* species group, *G. alenae* Kulhánek is distinguished by its mostly five to seven stronger and shorter radial spines spreading downwards, by its receptacle with protruding style and by its stamen arrangement with the primary row of stamens adherent to the receptacle base and distinctly separated from the other stamens, which are inserted on the receptacle wall.

Partly related to *G. affine* Řepka, *G. alenae* Kulhánek is distinguished by its solitary plants, smaller body size and smaller number of spines, by its much earlier flowering period, because when *G. alenae* starts fruiting *G. affine* Řepka begins to flower, and also by its shorter pericarpel and smaller fruits.

Tab. 1: Comparison of morphologically differentiated characters between *G. alenae* Kulhánek, *G. taningaense* Piltz, *G. affine* Řepka. Measurements for the new species were taken from field records combined with 6 years' observation in culture. Characteristics for the other two compared taxa of the comparison were taken from the protologues (Piltz, 1990; Řepka, 2015). (*character not included in protologue and measured by the author in culture).

	G. alenae	***G. taningaense***	***G. affine***
Body	flat-flattened globose, single	flattened globose, single	flat, single or offsetting
Ribs	(7-)8-13, flat-slightly convex	9-11, flat	(8-)10-12(-14), flat
No. of radial spines	5-7(-9)	7-11	7-9(-11)
No. of central spines	0(-1)	1-2	0
Spine length	(2-)3-6 mm	3-8 mm, central up to 11 mm	3.5-5(-10) mm
Colour of spines	horny - dark honey coloured in whole length with shiny distinctive base	red brown, gray brown to gray, darker at base	ivory coloured or pink, unicoloured, exceptionally darker at base
Flower size	(37-)40-55 mm long and 35-45 mm wide	40-55(*-65) mm long and 30-45 mm wide	40-55 mm long and 30-35 mm wide
Perigone shape	narrow funnel form or slightly broader funnel form	narrow, bell form	broad funnel shape

	G. alenae	*G. taningaense*	*G. affine*
Receptacle	narrow, funnel shape, 10-14 mm height	narrow, up to 11 mm height (up to 16 mm *)	campanulate, 8-12 mm height *
Filament length	5-9 mm	up to 10 mm	7-10 mm *
Style length	12-15 mm (excluding protruding part), style protruding to ovary	10-12 mm, style not protruding to ovary	10-13 mm, style protruding to ovary
Pericarpel	12-17 mm x 6-8 mm	* 13-18 mm	17-20 mm long
Fruit	obovate to clavate or fusiform, 15-23 x (8-)10-14 mm	ovate – clavate, 15-30 mm	obovoid with pedicel, (20-)24-33(-35) mm x (13-)15-20(-25) mm
Seeds	1.1-1.4 mm x 1.1-1.2 mm	1.2-1.4 mm x 1.0-1.2 mm	(1.05-)1.2-1.3 mm x 1.15-1.2(-1.25) mm
Flowering period (in habitat)	October to mid November	October to mid November	end of November to January

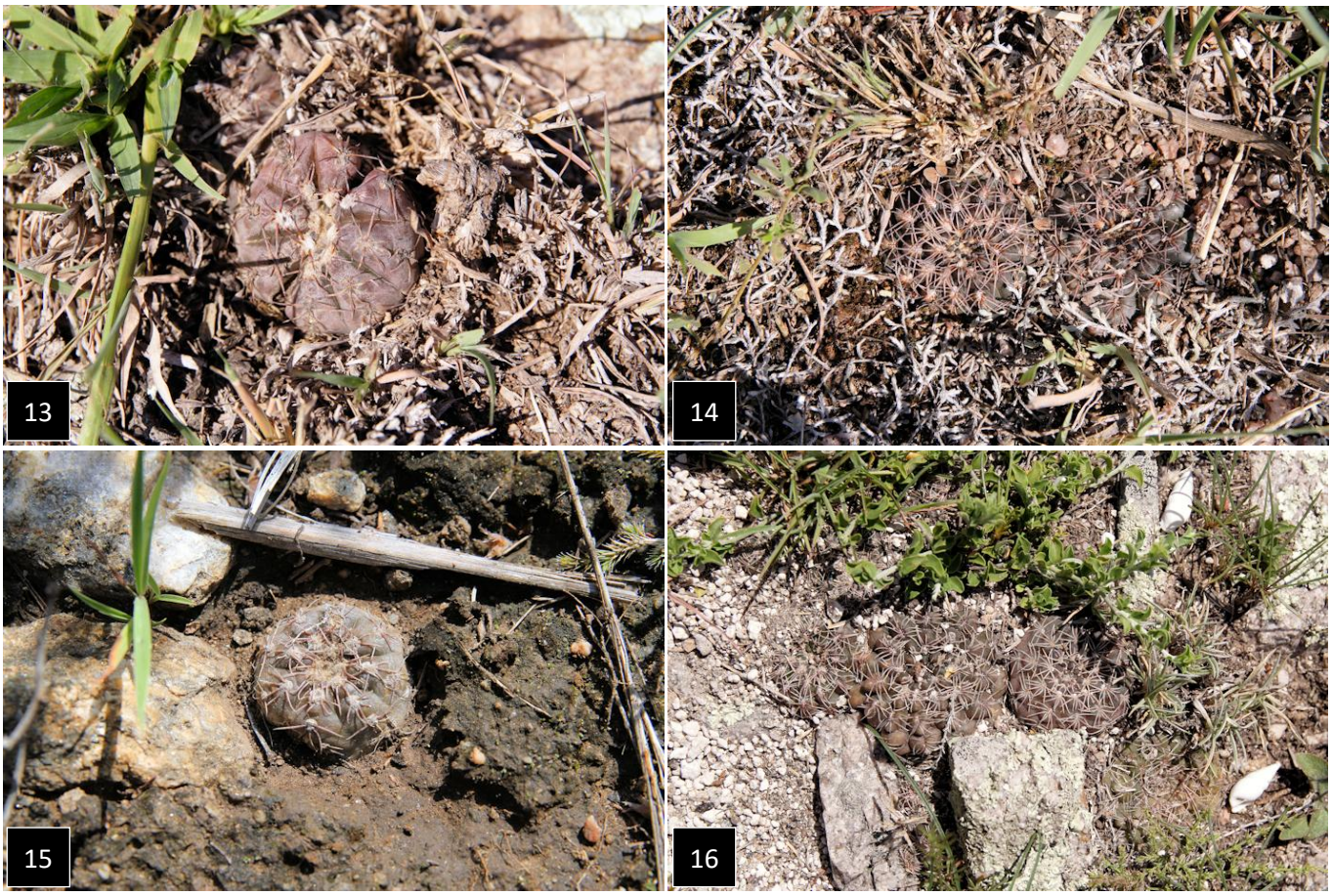

Fig. 13-16: Possible “ancestors” of *Gymnocalycium alenae* in the population of Tom 502, *Gymnocalycium* with morphology affiliated to the *G. taningaense* Piltz species group (13); *Gymnocalycium* with morphology affiliated to *G. affine* (14); *G. taningaense* Tom 12-565/2 (15); *G. affine* Tom 09-504/1 (16).

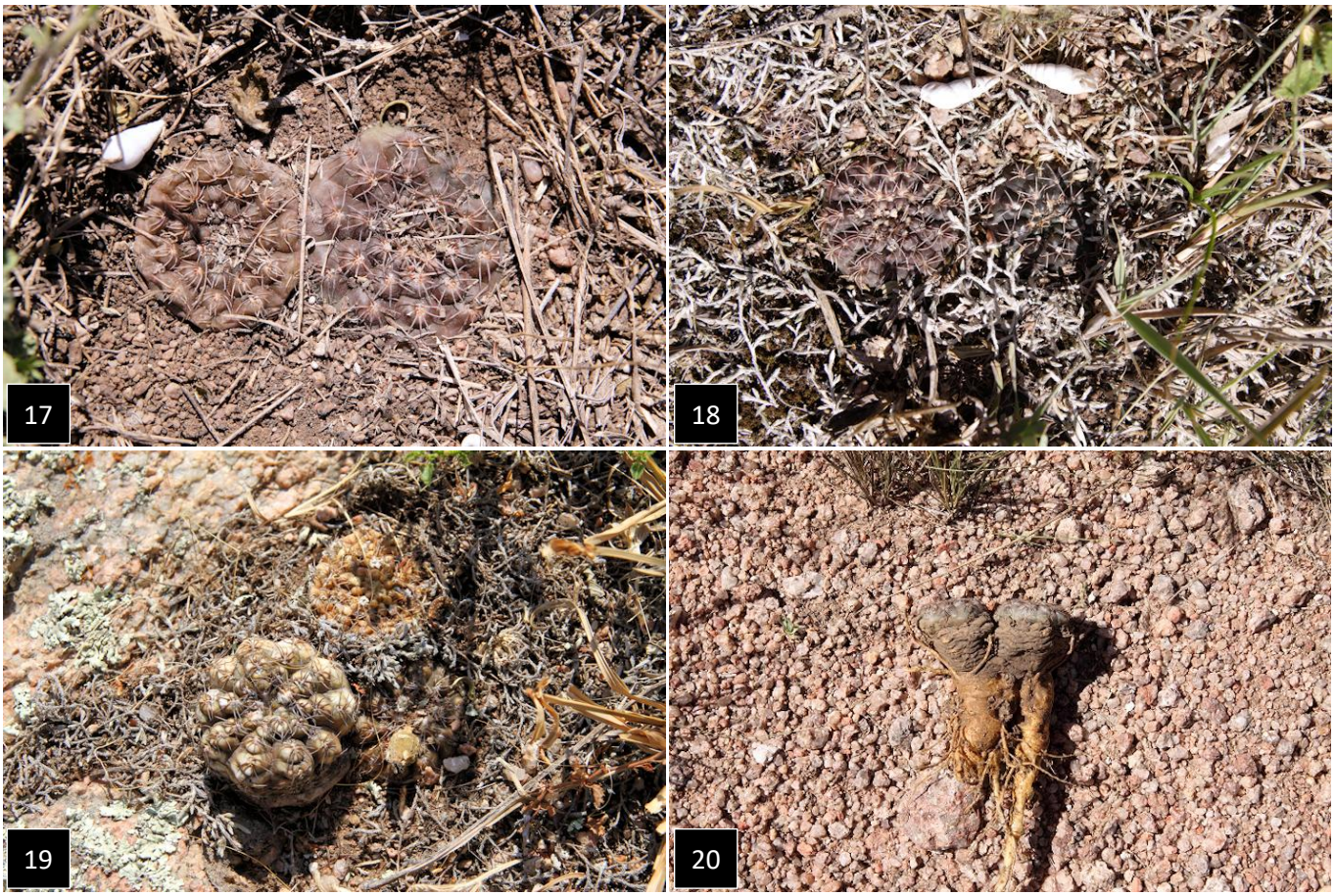

Fig. 17-20: *G. alenae* Tom 502/1, typical plants with intermediate morphological character (17-18); *G. alenae* Tom 502/1, burned plants with mummified fruit (19), *G. alenae* TS 166, taproot, photo: T. Strub (20).

DESCRIPTION

Plant body flat to flattened globose, larger part of stem below ground, in dry season embedded in the soil, (23-)27-40(-45) mm in diameter and 20-30 mm tall; epidermis grey-green, mostly with darker bronze tinge in the sun; root thick, composed of one or two major branches, presence of aerial side roots; ribs (7-)8-13, flat or slightly convex, straight, longitudinal furrows broad and deep; transverse cleft short and not so sharp, usually limited to the median part of the rib in younger plants, crossing the entire rib in older plants, joining two longitudinal furrows if plant is not fully turgid; tubercles obtuse, but prominent in fully turgid plants, placed below the areoles, just above the transverse cleft, in older plants more compressed, forming small, prominent chins. Areoles 1.5-2 x 2 mm, round to ovate, 4-7 mm distant from each other, with horny-whitish hair. Spines show the same colour in all parts of the stem, horny-coloured to dark honey-coloured over the whole length with a more intensely shiny base of the spines, rarely with a dark brown base, spines in section in part round, relatively thin, part of spines in old plants slightly flattened; marginal spines 5-7(-9), (2-)3-6 mm long, radially arranged, rigid, straight or usually bent over the tubercles and in some old plants irregularly spaced, lower spine shorter, usually 1, often a second pair or second and third pairs of lateral spines longer; central spines 0(-1) in adult plants, stiff and rigid just like radial spines, same length as radial spines. Flowers bisexual, (37-)43-55 mm long and 35-45 mm wide when fully open; flower bud obovate, narrow with sharp tip; pericarpel shorter than perigone, average ratio pericarpel : perigone = 1 : 2.4, olive-green to grey-green, 13-18 mm long, 6-8 mm wide, with about 8 dark olive green scales on the margins

fading to a white-rose colour, basal scales smaller with sharp tips; perigone narrow funnel form or slightly broader funnel form, outer petals from short spatulate to oval, progressively longer, up to 21 x 4-7 mm, on the outer side dark olive green in the central part and brown-purplish in the upper part, fading to white or pale rose at the margins, whitish cream on the inner side; inner petals lanceolate to oblong, 15-26 x 3-5 mm, whitish cream with inconspicuous central strip; receptacle narrow, inside dark pink, with conspicuously protruding style, 10-14 mm height; ovary oblong, style cream white in all parts, 1.4 mm in section at base, distal not narrowed,12-15 mm long and protruding part up to 2 mm; stigma lobes 8-10; stamens inserted on the receptacle wall, primary stamens in a row distinctly separated from others and adherent to receptacle base, filaments 5-9 mm long, filaments of first stamens rose at base, other filaments whitish cream, apices of uppermost filaments exceeding stigma lobes; anthers white. Ovary oblong 10-12 x (3-)4-5 mm, carpellar space white. Fruit obovate to clavate or fusiform, 15-23 x (8-)10-14 mm, dark olive green often with glaucous covering, drying fruit with rose tinge, dried fruit 12-18 x 0.6-11 mm. Seed round to broadly oval, 1.1-1.4 mm long and 1.1-1.2 mm broad, black, almost matt, border distinctly narrowing towards hilum, cells round, smaller towards hilum, anticlinal boundaries broad, shallowly channelled, curved, periclinal walls very slightly convex in median part, surface with scattered patches of cuticle; hilum basal, broadly oval, impressed, with very thin spongy coating, almost absent from HMR and slightly more distinct around margin.

Fig. 21-23: Differentiated morphological characters of flowers; *G. alenae* Tom 09-502/1 (21), *G. taningaense* P 212 (22), *G. affine* Tom 09-505/2 (23).

Fig. 24: *G. alenae* Tom 09-502/1, flower buds (mature plants after 8 years in cultivation, pot Ø 10 cm).

Fig. 25: *G. alenae* Tom 09-502/1, flowers.

Fig. 26: *G. alenae* Tom 09-502/1, flowers.

Fig. 27: *G. alenae* Tom 09-502/1, flower sections, yellow scale bar: 10 mm.

Fig. 28-30: *G. alenae* Tom 09-502/1, flower in full anthesis (28), fruits (29), ripe and dried fruits (30), yellow scale bar: 10 mm.

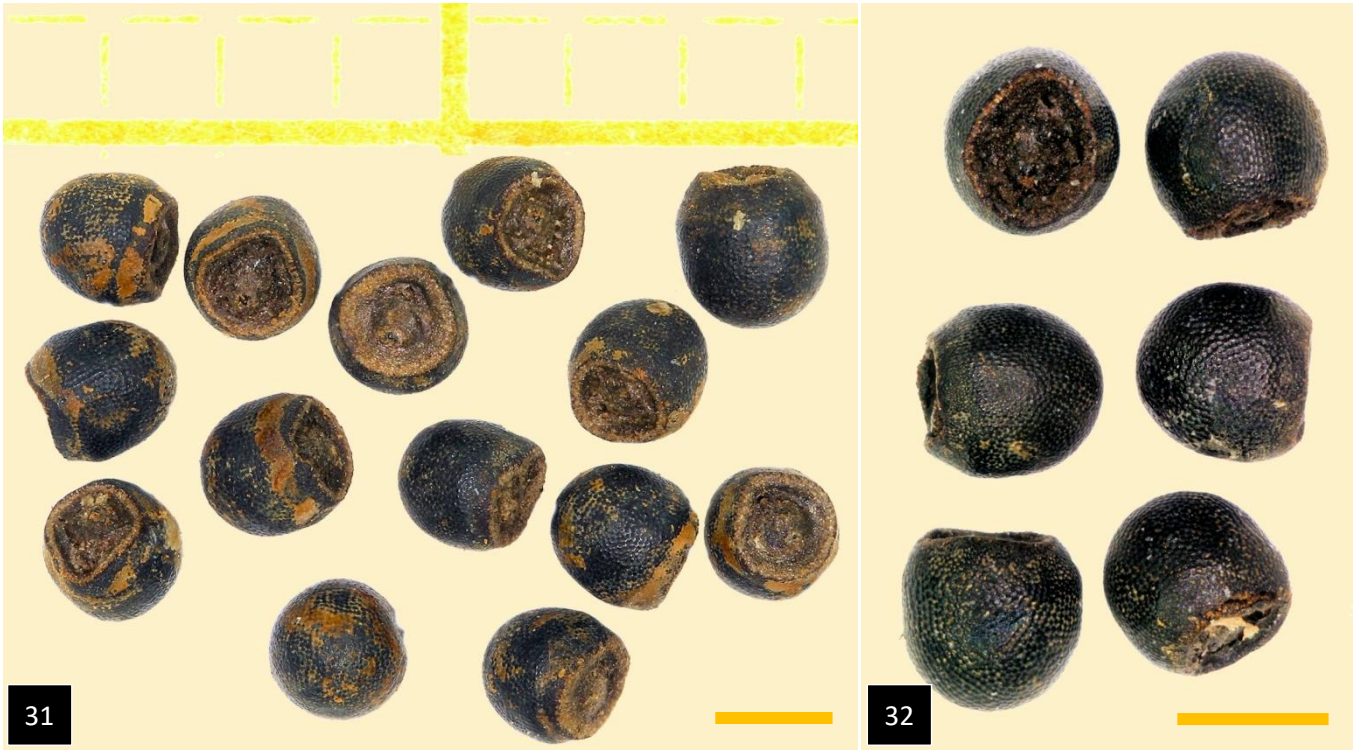

Fig. 31-32: *G. alenae* Tom 502/1, seeds and their variability, yellow scale bar: 1 mm (photos: V. Schädlich).

ETYMOLOGY

The epithet of new species is dedicated to the author's daughter Alena.

PHENOLOGY

G. alenae Kulhánek is an early flowering species, flowering in the same time period as species of the *G. taningaense* - *lukasikii* group (October to mid November in Argentina). *G. affine* Řepka forms flowers much later (end of November to January in Argentina). *G. alenae* Kulhánek already has ripening fruits at this time.

DISTRIBUTION AND HABITAT

The population of *G. alenae* Kulhánek has been found in a very dry, flat pasture area which extends on the west side of the southern part of the Sierra Sumampa in the vicinity of Estancia La Quinta (Fig. 1-2). Only one population of this species has been observed so far. The habitat extends in dry pasture, spreading on the borders of tertiary (Real et al., 2013) and quaternary deposits and Cambrian granitoid rocks (Ramos et al., 2015). Specimens occupy disintegrated edges of granitic plates and their crevices overgrown with species of *Selaginella* (Fig. 1, 8, 19) or are deeply embedded in brown loamy soil containing granitic and clay particles (Fig. 10, 12, 17). Shrub coenoses belonging to the Chaco Serrano formation are strongly degraded and influenced by grazing. *Acacia caven* Molina (*Fabaceae*) was the dominant shrub commonly seen here associated with *Aloysia gratissima* (*Verbenaceae*), *Condalia microphylla* (*Rhamnaceae*) and *Schinus fasciculatus* (*Anacardiaceae*). *Tritrinax campestris* (*Arecaceae*) grows sympatrically, not occurring directly in the habitat, but abundant in its vicinity. Several other species of the *Cactaceae* family could be found syntopically: *Echinopsis lamprochlora*, *Echinopsis leucantha* and *Opuntia sulphurea*.

Fig. 33-34: Other *Cactaceae* syntopically growing in habitat with *G. alenae* Tom 502/1, *E. leucantha* (33), *E. lamprochlora* (34).

VARIABILITY AND RELATIONSHIP

The population consists of specimens of different sizes. Young seedlings are deeply embedded in the soil or completely hidden below *Selaginella*. Only a few plants reaching a size over 4 cm have been found (Fig. 4). Specimens which occupy crevices filled by soil mostly have problems to survive in this very hot and dry summer climate (Fig. 19). At first glance some plants are reminiscent of small specimens of *G. affine* Řepka and on the other hand some of them show morphological characteristics of *G. taningaense* Piltz. Only a few individuals could be clearly attributed to one of these two species according to morphological characters of vegetative organs (Fig. 13-16). Most plants in the population represent the described features of this new taxon. Variability has also been studied in culture on flowering seedlings grown from seeds collected in habitat. Differentiating morphological characters of all these *Gymnocalycium* taxa are compared in Tab. 1. *G. taningaense* Piltz overlaps in several characters, namely body size and outer flower morphology: flower buds, flower size, shape, number of scales, colour of scales and petals and in flowering time. *G. alenae* Kulhánek presents other morphological characters missing in the *G. taningaense* species group but similar to *G. affine* Řepka: style is strongly protruding into the ovary (1.5-2 mm), primary row of stamens are adherent to receptacle base and distinctly separated by a space (1.8-2.5 mm) from other stamens inserted on receptacle wall (Fig. 21-23), some plants in the population form broader funnel form perigones in contrast to narrow funnel-bell form in *G. taningaense* Piltz. Some other characters can be more intermediate: number of ribs mostly 8 in young to13 in very old plants, shape of tubercles, length and colour of spines, of which young plants have 5-7 straight ones, whereas in older plants they are mostly bent over the bumps.

Evidence of these obtained characteristics could support the hypothesis of this taxon's hybridogenous origin. This would mean that the population of *G. alenae* was formed by hybridization and introgression of both ancestor taxa occurring or used to occur in the vicinity of the distribution area (Řepka et al, 2015). We know about many populations of *G. affine* Řepka occurring in the southern part of the Sierra Sumampa, NE of San Francisco de Chañar and in close vicinity of the population of *G. alenae* Kulhánek. But to date no population belonging to the *G. taningaense* species group has been discovered occurring in those surroundings. On the other hand crossbreeding of *G. taningaense* with other later flowering species in habitat has not been observed yet. But this would be theoretically possible during the time of a second

flowering period in December caused by the impact of climatic changes. This phenomenon could sometimes be seen in culture, it can also be found in the picture of Jörg Piltz published in his article about *G. taningaense* (Piltz, 1990). Based on current knowledge of the ecology of *G. taningaense* naturally occurring on Pampa de Pocho (west Córdoba) or *G. lukasikii* s.l. (San Luis) we could find similar coenoses in western direction of the distribution area of *G. alenae* Kulhánek. These possible habitats on grassy pastures require further study.

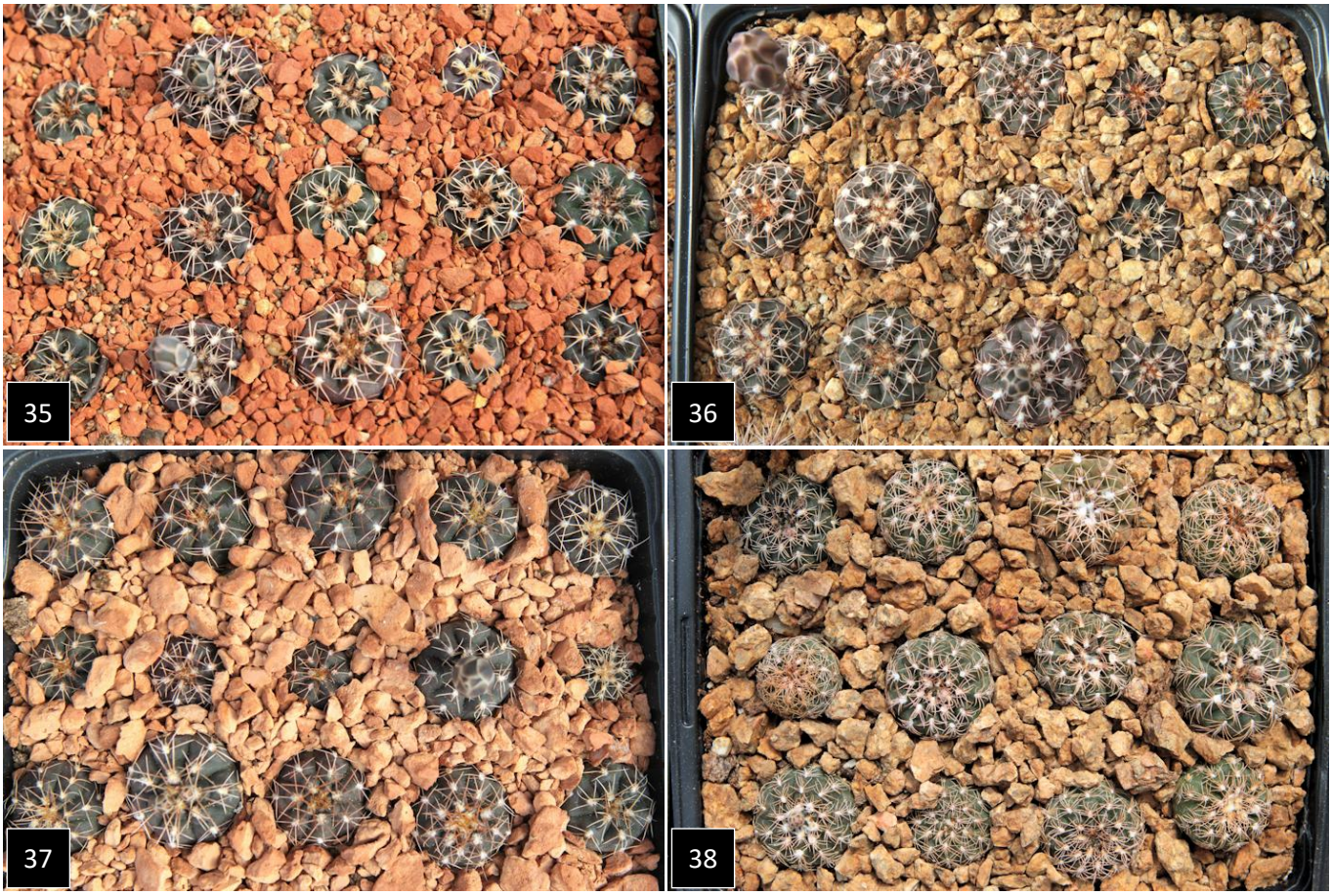

Fig. 35-38: Seedlings of compared *Gymnocalycium* species; *G. alenae* Tom 09-502/1 (35), *G. alenae* Tom 12-502/1 (36), *G. taningaense* VG-304 (37), *G. affine* Tom 505/2 (38).

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Photos by the author if not indicated differently.

CITED FIELD NUMBERS

P 212, Arg. Córdoba, Taninga → Salsacate, 950 m

Tom 09-502/1 (=Tom 12-502/1), Arg., Córdoba, 10 km SE of San Francisco de Chañar, 648 m

Tom 09-504/1, Arg., Córdoba, X on the way from San Francisco de Chañar → R 9, 621 m

Tom 09-505/2, Arg., Córdoba, R 9, 200 m N of San Miguel, 552 m

Tom 12-565/2, Arg., Córdoba, 10 km S Ambul → Panaholma, 6 km S Santa Rosa, 1086 m

TS 166, Arg., Córdoba, 10 km SE of San Francisco de Chañar, 648 m

VG-304, Arg., Córdoba, Pocho, 1076 m

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